(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 April 2002 (11.04.2002)

PCT

(10) International Publication Number
WO 02/30088 A1

(51) International Patent Classification[7]: H04L 29/06, 29/08, G06F 17/30, H04L 12/18

(21) International Application Number: PCT/US01/31316

(22) International Filing Date: 4 October 2001 (04.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/684,384 4 October 2000 (04.10.2000) US

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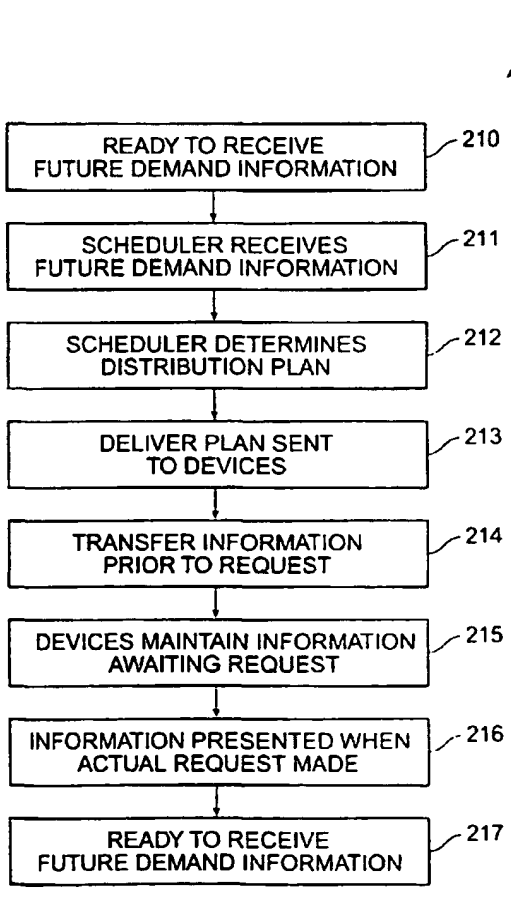
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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: ADAPTIVE PREDICTIVE DELIVERY OF INFORMATION



(57) Abstract: The invention provides a technique for transferring data from a source to a relatively large number of clients that is not subject to the drawbacks of the known art. This can be achieved by using both known and predicted demand for content required at selected times in the future, selecting times earlier than when information is required and adaptively using transmission capacity, schedulijg (i.e. timing of transmissions) and multicast grouping to deliver that information to a plurality of clients.

WO 02/30088 A1

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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ADAPTIVE PREDICTIVE DELIVERY OF INFORMATION

Background of the Invention

1. *Field of the Invention*

This invention relates to adaptive predictive delivery of information, including delivery of information at a time earlier than the information is requested, such as for use in an internetworking environment.

2. *Related Art*

In the World Wide Web, client devices (also called "web browsers") make requests for information from server devices (also called "web sites"), receive that information from the server devices, and deliver that information at those client devices to end-users. One problem when using the World Wide Web is that a rate of transfer of information from the server to the client is sometimes much less than desired. This problem is particularly acute when information to be transferred is requested at or about the same time by a relatively large number of clients.

A first known method is to deliver information to a relatively large number of clients on demand (i.e. immediately in response to a client request). This can be achieved by trying to respond to each demand individually. Devices and systems using this known method include mirrored web servers. While this known method generally achieves the result of delivering information more rapidly at a plurality of clients, it is still subject to several drawbacks. First, devices and systems using this method must have the information they deliver coordinated, so that when requested information is identical when served by any mirrored server. Second, devices and systems using this method use significant information transmittal

capacity when relatively large numbers of clients request the same information which often requires scaling up of the number of responding devices to meet demand.

A second known method for attempting to deliver information to a relatively large number of clients is to use a prearranged schedule for transmission of content. Clients then select to receive transmissions at the scheduled times. Thus, the service aggregates demand into a prearranged schedule that is convenient for the server. In an Internet protocol (IP) network this can be achieved using IP multicast, so that information can be duplicated by each router, conserving resources. Standard television broadcasting also fits this model of information delivery. While this known method generally achieves the result of delivering information to a plurality of clients, it is still subject to several drawbacks. First, it is generally only applicable in dealing with live broadcasts of information where the end client has no control over the presentation. Secondly, devices and systems that use this method use relatively fixed schedules, and do not consider information regarding known and projected demand for content amongst the client population.

Accordingly, it would be advantageous to provide a technique for transferring data from a source to a relatively large number of clients, that is not subject to the drawbacks of the known art. This can be achieved by using both known and predicted demand for content required at selected times in the future, selecting times earlier than when information is required and adaptively using transmission capacity, scheduling (i.e. timing of transmissions) and multicast grouping to deliver that information to a plurality of clients. Thus, reducing the total consumption of resources required to deliver a given content to all requesting clients and to deliver all content to all requesting clients.

Summary of the Invention

The invention provides a method and system for transferring data from a source to a plurality of clients that is not subject to the drawbacks of the known art.

This can be achieved by using both known and predicted/projected demand (herein referred to as "total demand") for content required at selected times in the future, selecting times earlier than when information is required and adaptively using transmission capacity, scheduling (i.e. timing of transmissions) and multicast grouping to deliver that information to a plurality of clients.

The invention provides an enabling technology for a wide variety of applications for delivery of content from a remote source to a plurality of clients, so as to obtain substantial advantages and capabilities that are novel and non-obvious in view of the known art. Examples described below primarily relate to the World Wide Web, but the invention is broadly applicable to many different types of systems in which delivery of preferred content is desired.

Brief Description of the Drawings

Figure 1 shows a block diagram of a portion of a system capable of transferring data from a source to a plurality of clients.

Figure 2 shows a process flow diagram of a method for operating a system as in figure 1.

Detailed Description of the Preferred Embodiment

In the following description, a preferred embodiment of the invention is described with regard to preferred process steps and data structures. Embodiments of the invention can be implemented using general-purpose processors or special purpose processors operating under program control, or other circuits, adapted to particular process steps and data structures described herein. Implementation of the process steps and data structures described herein would not require undue experimentation or further invention.

Lexicography

The following terms refer or relate to aspects of the invention as described below. The descriptions of general meanings of these terms are not intended to be limiting, only illustrative.

- client device, server device – In general, the phrase "client device" includes any device taking on the role of a client in a client-server relationship (such as an HTTP web client and web server). There is no particular requirement that client devices must be individual physical devices; they can each be a single device, a set of cooperating devices, a portion of a device, or some combination thereof. Similarly, the phrase "server device" includes any device taking on the role of a server in a client-server relationship. There is no particular requirement that server devices must be individual physical devices; they can each be a single device, a set of cooperating devices, a portion of a device, or some combination thereof.

- client, server – In general, the terms "client" and "server" refer to relationships between the client and the server, not necessarily to particular physical devices.

- source server – A server that contains the originating copy of a piece of content.

- scheduler – An element that controls the transfer of data between all servers and clients in a network so as to optimally deliver content from a server to a client. It is responsible for determining the timing of transmissions and optionally the formation of multicast groups.

- anticipated demand – Projected demand for content amongst a client population. This projection can be achieved by using the characteristics of the

content, the characteristics of the client population, and/or some combination of both.

- known demand – Demand for content which has been explicitly expressed by a client.

- total demand – The combination of known demand amongst a client population for a given piece of content and anticipated/projected demand for content amongst a client population.

- future demand – A general term meaning demand for content required at a collection of clients at some future time. Future demand could be anticipated demand, known demand, or total demand.

- multicast – A general term for any method that sends content from a source to multiple destinations.

- network resources – A general term for any property of an information delivery network that is available in a limited quantity. For example; link bandwidth, server cache capacity, and server transmission capacity.

- Adaptive scheduling – a method which uses the total demand, as defined above, to schedule the delivery of a set of content to a set of clients while minimizing the consumption of network resources.

As noted above, these descriptions of general meanings of these terms are not intended to be limiting, only illustrative. Other and further applications of the invention, including extensions of these terms and concepts, would be clear to those of ordinary skill in the art after perusing this application. These other and further applications are part of the scope and spirit of the invention, and would be clear to those of ordinary skill in the art, without further invention or undue experimentation.

System Elements

Figure 1 shows a block diagram of a portion of a system capable of transferring data from a source to a plurality of clients.

A system 100 includes a set of source servers 110, a set of destination devices (called herein "clients") 120, a communication network 130, and a scheduler 140.

Each server 110 is coupled to the communication network 130, and includes a processor, program and data memory, and mass storage, collectively disposed to maintain information content 111. The server 110 is capable of providing at least some portion of the content 111 in response to a request.

Similar to each server 110, each client 120 is coupled to the communication network 130, and includes a processor, program and data memory, and mass storage. The elements of each client 120 are collectively disposed to receive content 111, such as in response to a request.

A preferred embodiment is described herein with regard to "content" 111 that is presumed to include information that is relatively static (although the content 111 might be updated in response to time or in response to external events). However, in alternative embodiments, content 111 may be dynamically generated, such as in response to a state of a measurable system (such as for example telemetry or object-location circuits), in response to information in a database (such as for example stock prices or goods available for delivery), or in response to some combination or conjunction thereof.

In a preferred embodiment, the communication network 130 includes a store-and-forward network such as the Internet. In alternative embodiments, the communication network 130 may include alternative forms of communication, such

as an intranet, extranet, virtual private network, private or public switched network (such as a satellite or telephone system), direct communication links, or some other combination or conjunction thereof. In general, the scheduler 140 controls each server 110 and client 120 connected to the communication network 130. In an alternate embodiment the communication network 130 could itself be capable of receiving instructions from the scheduler 140 regarding sending, timing, or multicast or broadcast of information within the communication network 130.

Additionally, in alternate embodiments of the invention, it is contemplated that the communication network 130 may include any number of intermediate servers (not shown, but understood by one skilled in the art). These intermediate servers would function between the set of source servers 110 and the set of clients 120.

Similar to each server 110, the scheduler 140 is coupled to the communication network 130, and includes a processor, program and data memory, and mass storage, collectively disposed to perform the functions described herein.

The scheduler 140 includes a first input port 141, capable of receiving future demand information 142 regarding the communication network 130. As noted herein, future demand information 142 includes an identification of which portion of the content 111 (in a preferred embodiment, which of the elements forming a portion of the content 111) are intended to be delivered to which clients 120 by which times. The indicated times might be absolute time values (such as known time stamps), or might be relative time values (such as known offsets from a present time).

As noted herein, future demand information 142 might include either known demand information 143, which would refer to specific requests for at least a portion of the content 111 to be delivered to specific clients 120 at specific future times. For example, the schedule might glean future demand information 142 from requests by a set of clients 120 to receive a movie or other information scheduled to

be available at a known future time. The scheduler can then time delivery of the movie or other information and form multicast groups to "optimally" deliver the movie to the set of clients 120.

Alternatively, future demand information 142 might include anticipated demand information 144, which would refer to predicted likely requests for at least a portion of the content 111 to be delivered at predicted future times. In a preferred embodiment, the scheduler 140 determines a best prediction for anticipated demand information 144 in response to characteristics of the content 111, characteristics of clients 120, or characteristics of some combination or conjunction thereof.

- For a first example, if a specific portion of the content 111 includes a very popular movie, the scheduler 140 might determine anticipated demand information 144 in response to that information alone.

- For a second example, if a specific portion of the content 111 includes a Horror movie and a specific client 120 is known by the scheduler 140 to like horror movies, the scheduler 140 might determine anticipated demand information 144 in response to the combination of those two facts.

- For a third example, if a specific client 120 is known by the scheduler 140 to be in a specific time zone where the content 111 will be delivered at 3:00 a.m., the scheduler 140 might determine anticipated demand information 144 in response to that information alone.

In a preferred embodiment, sending and receiving of information between servers 110 and clients 120 may be adjusted by the scheduler 140 using the communication network 130 to optimize a selected objective measure. The scheduler, however 140, does not send or receive any of the information passing between the servers 110 and clients 120. The scheduler 140 controls the servers and

clients to adjust when information is sent in the communication network 130. Multicast grouping is controlled via the clients and servers.

Future demand information 142 input to the scheduler 140 represents anticipated and predicted demand for a set of future times, rather than a present time. Accordingly, the scheduler 140 can adjust timing of information delivery from servers 110, such as to times prior to when the information is actually needed at the client 120. Moreover, when timing of information delivery can be adjusted, the scheduler 140 can adjust multicast grouping to make optimal use of multicast delivery of information within the communication network 130.

For example, the scheduler 140 can receive requests to deliver a particular set of data (such as an online book containing hundreds of pages) to a relatively large number of clients 120. Without multicast grouping, the mere number of such requests might have the effect of overloading the server 110 having that portion of content 111. However, the scheduler 140, if it receives these requests in good time, can construct one or more multicast groups to allow the server 110 having that portion of content 111 to deliver the set of data to all interested clients 120 without undue load.

The scheduler 140 can be disposed to optimize to one or more of a set of different functions. For several examples, the scheduler 140 can attempt to optimize to one or more of, or some combination of, the following.

- Having been given a model of network link costs, the scheduler 140 can attempt to minimize total cost of sending information from servers 110 to clients 120.

- Having been given a model of bandwidth and latency between sub-elements of the communication network 130, the scheduler 140 can attempt to maximize

throughput (or to maximize bandwidth efficiency, or to minimize latency) in the communication network 130.

- Having been given a model of financial cost for early delivery, on-time delivery, and late delivery of information, the scheduler 140 can attempt to minimize total cost of sending information from servers 110 to clients 120. The scheduler 140 can alternatively or in addition attempt to minimize a difference between cost of sending information to clients 120 and a monetary value of those deliveries to those clients 120.

Method of Operation

Figure 2 shows a process flow diagram of a method for operating a system as in figure 1.

A method 200 includes a set of flow points and a set of steps. The system 100 performs the method 200. Although the method 200 is described serially, the steps of the method 200 can be performed by separate elements in conjunction or in parallel, whether asynchronously, in a pipelined manner, or otherwise. There is no particular requirement that the method 200 be performed in the same order in which this description lists the steps, except where so indicated.

At a flow point 210, the system 100 is in a quiescent state, and is ready to receive future demand information 142 regarding the communication network 130. As part of this quiescent state, the system 100 includes one or more servers 110 maintaining selected information for delivery upon request, and includes one or more clients 120 capable of requesting that selected information in response to activity local to those particular clients 120 (such as user action).

At a step 211, the scheduler 140 receives future demand information 142 regarding the communication network 130. As part of this step, in a preferred

embodiment, the scheduler 140 receives the future demand information 142 from one or more of, or some combination of, the following sources.

- The scheduler 140 can receive future demand information 142 from one or more servers 110. Each server 110 can determine future demand information 142 in response to known demand information 143 or in response to anticipated demand information 144. Each server 110 might determine known demand information 143 in response to request messages or information messages from one or more clients 120. Each server 110 might determine anticipated demand information 144 in response to information messages from one or more clients 110, in response to statistical information regarding past demand experience at that server 110, or some combination or conjunction thereof.

- The scheduler 140 can receive future demand information 142 from one or more clients 120. Each client 120 can determine future demand information 142 in response to known demand information 143 or in response to anticipated demand information 144. Each client 120 might determine known demand information 143 in response to local activity responsible for generating request messages from that particular client 120 to one or more servers 110. Each client 120 might determine anticipated demand information 144 in response to local activity of similar nature, in response to statistical information regarding past demand experience from that client 120, or some combination or conjunction thereof.

At a step 212, the scheduler 140 determines an optimal schedule which includes timing of information transfer, and grouping of transfers into multicasts for each of the servers and clients in the network, so as to satisfy future demand. As a part of this step the scheduler 140 attempts to optimize one or more functions as described with regard to figure 1. The scheduler 140 can be configured to optimize

delivery based on a plethora of criteria (for example, minimizing costs and maximizing use of available bandwidth).

At a step 213, the scheduler 140 (utilizing control information 146) directs servers 110, clients 120, and routers or switches in the communication network 130 to perform information transfers at selected times earlier than actual requests, so as to best satisfy the determination of the just-prior step.

At a step 214, the servers 110, clients 120, and routers or switches in the communication network 130 perform the information transfers directed by the scheduler, at the selected times (earlier than actual requests) selected by the scheduler 140.

At a step 215, the servers 110 and clients 120 maintain transferred information at receiving elements until the actual requests for information transfer are made.

At a step 216, the clients 120 deliver transferred information to receiving software elements when the actual requests for information transfer are made.

At a flow point 217, the system 100 is in a quiescent state, and is ready to repeat the steps between the flow point 210 and the flow point 217.

Generality of the Invention

The invention has general applicability to various fields of use, not necessarily related to the services described above. For example, these fields of use can include one or more of, or some combination of, the following:

- The invention is generally applicable to methods and systems where information is desired to be transferred at a time other than the time that information is requested, so that the information transfer is "time shifted" from the information request.

- The methods employed are equally applicable to wireless networks, cabled networks, and satellite networks.

Other and further applications of the invention in its most general form, will be clear to those skilled in the art after perusal of this application, and are within the scope and spirit of the invention.

Although preferred embodiments are disclosed herein, many variations are possible which remain within the concept, scope, and spirit of the invention, and these variations would become clear to those skilled in the art after perusal of this application.

Alternative Embodiments

Although preferred embodiments are disclosed herein, many variations are possible which remain within the concept, scope, and spirit of the invention, and these variations would become clear to those skilled in the art after perusal of this application.

Claims

1. A method including;
determining a measure of future demand;
optimizing total network resource consumption in response to said measure; and
delivering, using optimized consumption, content from source servers to clients.

2. A method of claim 1, wherein said determining is accomplished by one or more server devices.

3. A method of claim 2, wherein said server determines future demand in response to known demand information.

4. A method of claim 2, wherein said server determines future demand in response to anticipated demand information.

5. A method of claim 2, wherein said server determines future demand from total demand.

6. A method of claim 2, wherein said server determines known demand information in response to request messages.

7. A method of claim 2, wherein said server determines known demand information in response to information from one or more clients.

8. A method of claim 2, wherein said server determines demand information in response to statistical information regarding past demand experience at said server.

9. A method of claim 1, wherein said determining is accomplished by one or more client devices.

10. A method of claim 9, wherein said client determines future demand in response to known demand information.

11. A method of claim 9, wherein said client determines future demand in response to anticipated demand information.

12. A method of claim 2, wherein said client determines future demand from total demand.

13. A method of claim 9, wherein said client determines known demand information in response to request messages originating from said client to one or more servers.

14. A method of claim 9, wherein said client determines demand information in response to statistical information regarding past demand experience at said client.

15. A method of claim 1, wherein said optimizing is performed by a scheduling module.

16. A method of claim 15, wherein said optimizing is based on a plurality of user-selectable criteria.

17. A method of claim 1, wherein said delivery uses multicasting to simultaneously deliver content to a plurality of clients.

18. A method of claim 1, wherein said content is cached in the home.

19. An apparatus including;
means for determining a measure of future demand;
means for optimizing total network resource consumption in response to said measure; and
means for delivering, using optimized consumption, content from source servers to clients.

20. The apparatus of claim 19, wherein said means of determining is accomplished by one or more server means.

21. The apparatus of claim 20, wherein said server means determines future demand in response to known demand information.

22. The apparatus of claim 20, wherein said server means determines future demand in response to anticipated demand information.

23. The apparatus of claim 20, wherein said server means determines future demand from total demand.

24. The apparatus of claim 20, wherein said server means determines known demand information in response to request messages.

25. The apparatus of claim 20, wherein said server means determines known demand information in response to information from one or more clients.

26. The apparatus of claim 20, wherein said server means determines demand information in response to statistical information regarding past demand experience at said server.

27. The apparatus of claim 19, wherein said means for determining is accomplished by one or more client means.

28. The apparatus of claim 27, wherein said client means determines future demand in response to known demand information.

29. The apparatus of claim 27, wherein said client means determines future demand in response to anticipated demand information.

30. The apparatus of claim 27, wherein said client means determines future demand from total demand.

31. The apparatus of claim 27, wherein said client means determines known demand information in response to request messages originating from said client to one or more servers.

32. The apparatus of claim 27, wherein said client means determines demand information in response to statistical information regarding past demand experience at said client.

33. The apparatus of claim 19, wherein said means for optimizing is performed by a scheduling module.

34. The apparatus of claim 32, wherein said means for optimizing is based on a plurality of user-selectable criteria.

35. The apparatus of claim 19, wherein said means for delivery uses multicasting to simultaneously deliver content to a plurality of clients.

36. The apparatus of claim 19, wherein said content is cached in the home.

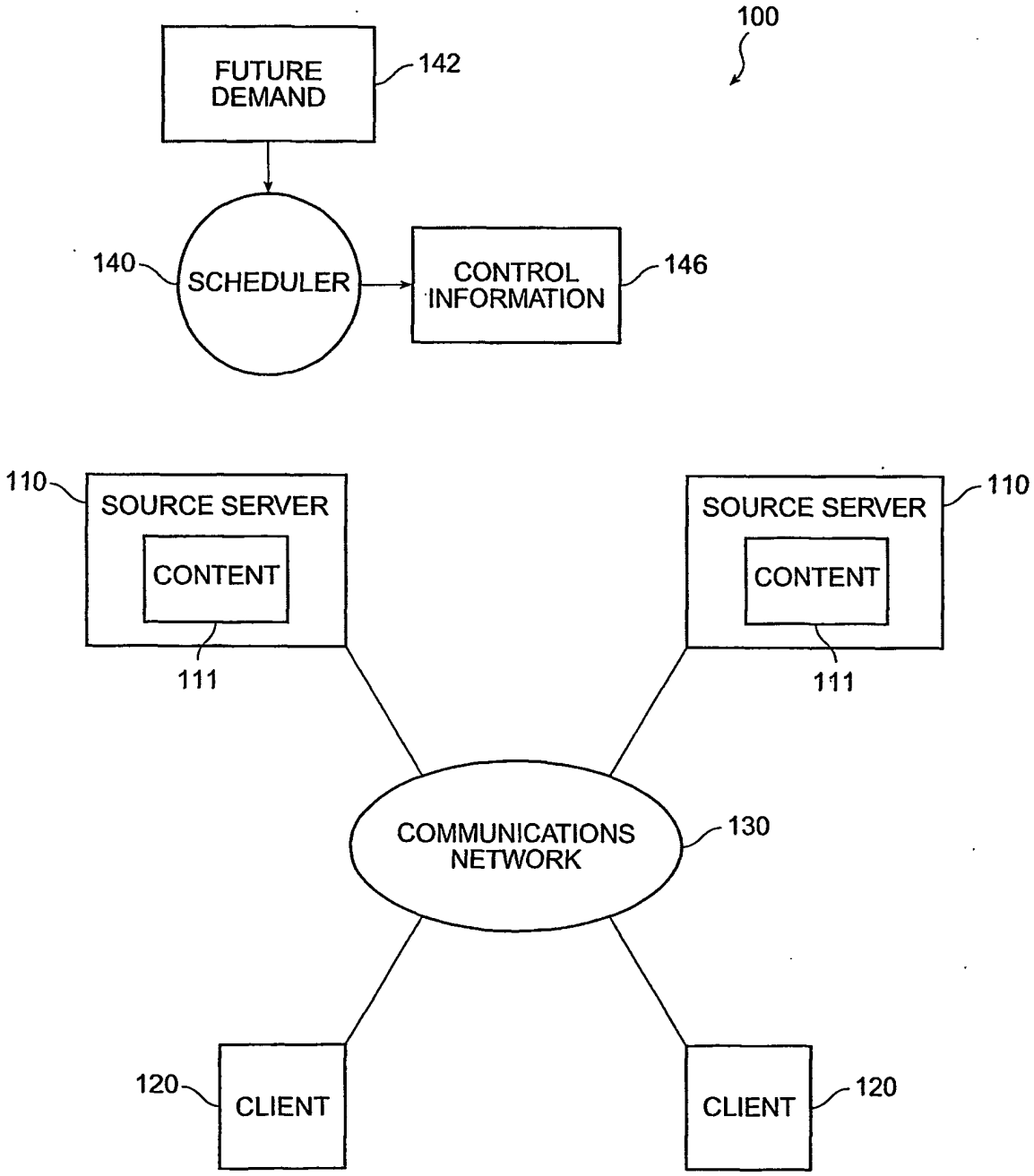

100
FUTURE DEMAND
142
140
SCHEDULER
CONTROL INFORMATION
146
110
SOURCE SERVER
CONTENT
111
110
SOURCE SERVER
CONTENT
111
COMMUNICATIONS NETWORK
130
120
CLIENT
120
CLIENT

FIG. 1

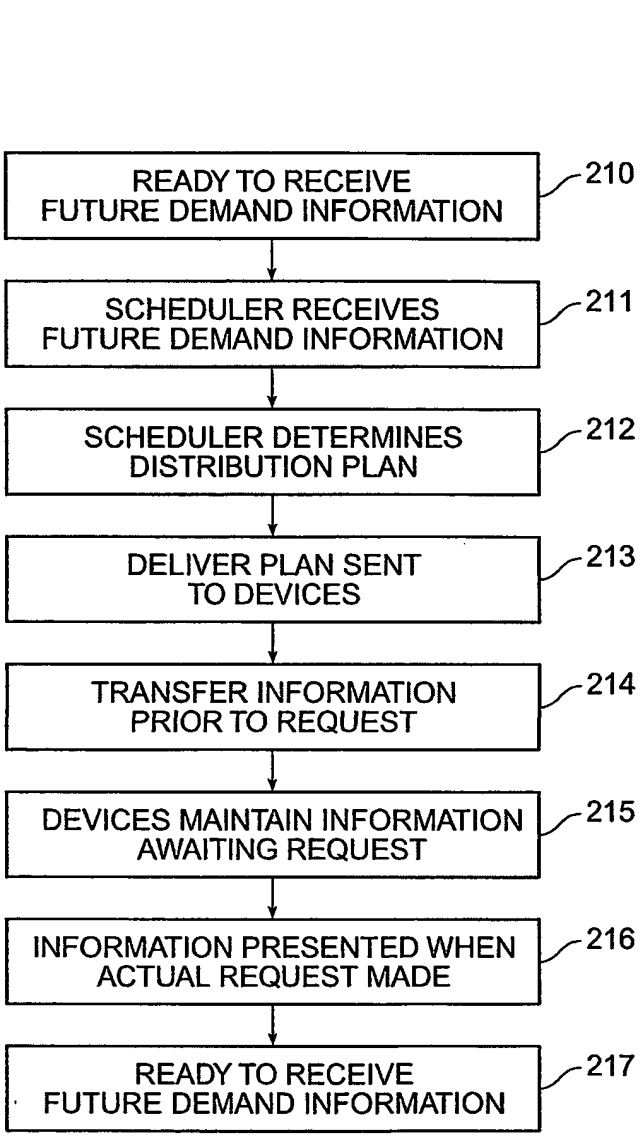

200
READY TO RECEIVE FUTURE DEMAND INFORMATION
210
SCHEDULER RECEIVES FUTURE DEMAND INFORMATION
211
SCHEDULER DETERMINES DISTRIBUTION PLAN
212
DELIVER PLAN SENT TO DEVICES
213
TRANSFER INFORMATION PRIOR TO REQUEST
214
DEVICES MAINTAIN INFORMATION AWAITING REQUEST
215
INFORMATION PRESENTED WHEN ACTUAL REQUEST MADE
216
READY TO RECEIVE FUTURE DEMAND INFORMATION
217

FIG. 2

International Application No
PCT/US 01/31316

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/06 H04L29/08 G06F17/30 H04L12/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RODRIGUEZ P ET AL: "Improving the WWW: caching or multicast?" COMPUTER NETWORKS AND ISDN SYSTEMS, NORTH HOLLAND PUBLISHING. AMSTERDAM, NL, vol. 30, no. 22-23, 25 November 1998 (1998-11-25), pages 2223-2243, XP004152174 ISSN: 0169-7552	15-18, 33-36
X	page 2224, left-hand column, paragraph 3 page 2224, right-hand column, last paragraph page 2227, left-hand column, paragraph 3 page 2227, right-hand column, paragraph 1 page 2241, left-hand column, paragraph 2 -right-hand column, paragraph 3	1-14, 19-32

-/--

[X] Further documents are listed in the continuation of box C.

[] Patent family members are listed in annex.

° Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2002	13/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Huber, O

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WANG Z ET AL: "Prefetching in World Wide Web" GLOBAL TELECOMMUNICATIONS CONFERENCE, 1996. GLOBECOM '96. 'COMMUNICATIONS: THE KEY TO GLOBAL PROSPERITY LONDON, UK 18-22 NOV. 1996, NEW YORK, NY, USA,IEEE, US, 18 November 1996 (1996-11-18), pages 28-32, XP010220168 ISBN: 0-7803-3336-5	16-18, 34-36
A	page 28, right-hand column, last paragraph -page 29, right-hand column, paragraph 4 page 30, right-hand column, last paragraph -page 31, left-hand column, paragraph 1	15,33
X	NONNENMACHER J ET AL: "ASYNCHRONOUS MULTICAST PUSH: AMP" ICCC'97. 13TH INTERNATIONAL CONFERENCE ON COMPUTER COMMUNICATION. KEYS TO A MATURE INFORMATION SOCIETY. CANNES, NOV. 18 - 21 1997, PROCEEDINGS OF INTERNATIONAL CONFERENCE ON COMPUTER COMMUNICATION, ÄS.L.Ü: ÄS.NÜ, vol. CONF. 13, 18 November 1997 (1997-11-18), pages 419-430, XP000753920 ISBN: 2-7261-1104-1 page 419, left-hand column, last paragraph -right-hand column, paragraph 2 page 420, left-hand column, paragraph 4 -right-hand column, paragraph 4 page 424, left-hand column, paragraph 1 - paragraph 5	15,17, 18,33, 35,36

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1-14,19-32

The initial phase of the search revealed a very large number of documents relevant to the issue of novelty. So many documents were retrieved that it is impossible to determine which parts of claims 1-14 and 19-32 define subject-matter for which protection might legitimately be sought (Article 6 PCT). For these reasons, a meaningful search over the whole breadth of claims 1-14 and 19-32 is impossible. The particular resons are that:
- No designation of the subject matter is present, therefore the method and apparatus would apply to anything from a beverage delivery firm or a mail order company, organising its deliveries.
- No actual technical features are present in claims 1-14 and 19-32.

Consequently, the search has been restricted to Claims 15-18 and 33-36 which puts the claims into a certain context.

Furthermore, present claims 1-14 and 19-32 relate to a method and apparatus defined by reference to desirable characteristics, namely "... determining a measure of a furure demand" and "... optimizing ... consumption ... delivering, using otimized consumption".

The claims cover all methods and apparatus having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT for only a very limited number of such methods and apparatus. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the method and apparatus by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to the methods and apparatus

- a scheduling module,
- user selectable criteria,
- multicast for delivery and
- cached content,

as described in Claims 15-18 and 33-36.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.